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PSYCHOLOGY

PAPER 1 - UNIT-6 Learning

Concepts and theories of learning (Behaviourists, Gestaltist and Information Processing Model); The processes of extinction, discrimination and generalization; Programmed learning, probability learning, self instructional learning, concept, types and the schedules of reinforcement; Modeling and social learning.

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LEARNING

Human beings are very complicated organisms. We live for a comparatively long time in environments that are constantly changing. To survive in these environments, we must adapt. Adaptation is the process of changing behavior to fit changing circumstances. Learning is an adaptive process because it enhances our ability to change. Finding food and shelter, avoiding danger, reading, making friends all these activities require learning. In fact, it is difficult to think of many activities that do not require some sort of learning.

Because learning is so important to our survival, psychologists have devoted much time to its study. Learning also plays an important role in many other areas of psychological inquiry. For example, in the area of social psychology, learning may explain why children who watch television violence tend to be more aggressive. Learning may also play a role in acquiring certain types of fears. Interestingly, therapy designed to eliminate these fears often applies learning principles to help "unlearn" the fear. Learning may also play a role in developmental processes such as identifying with the appropriate sex and acquiring language.

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WHAT IS LEARNING

Learning can be defined as a relatively permanent change in immediate or potential behavior that results from experience. This definition has three critical aspects: (1) learning involves a change in either immediate or potential behavior; (2) the change must be relatively permanent; and (3) the change must be due to experience. To fully appreciate this definition, let's consider one of psychology's

favorite examples, that of a hungry rat learning its way through a maze.

The rat is placed in the start box and allowed to run to the choice point in the maze. Here, the rat must learn to turn either right or left to obtain a small pellet of food. The first few times it runs the maze, the rat sometimes turns to the right and sometimes to the left. But as it gains more and more experience, the rat begins to turn right on every try. At this point, the rat is said to have learned.

Let's see how this process fits the three criteria of learning. The first criterion is that learning leads to a change in immediate or potential behavior. Because it is impossible to observe the internal process of learning, psychologists infer that learning has taken place only if behavior changes. The rat in the maze meets this criterion. Although it initially ran both to the left and to the right, the rat now runs only to the right. It is apparent that the rat has changed its immediate behavior.

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It is possible, however, for learning to occur without an immediate change in behavior. Consider the student who fails an exam. The student may have learned well but performed poorly. Perhaps the students were tired and nervous during the exam. On another day, when the student is rested and confident, performance might improve dramatically. Similarly, the rat might have learned to turn right to get food but may be ill and fail to perform. Even though both the rat and the student had learned, there was no immediate change in behavior. But in both cases, the organism does have the capacity to change its behavior at some future time. In these instances, there is a change in the potential behavior.

The second criterion is that the change in behavior must be relatively permanent. We could determine this by checking to see if the rat still ran to the right an hour or even a week later.

The third criterion of learning is that the behavior change must be due to experience. Experience includes practice, repetition, or training. The rat's change in behavior is due to experience since the animal had to be trained to turn right. By specifying that learning must be due to experience, we discount changes in behavior that are due to drugs, maturation, or illness.

How organisms learn has been a central question in psychology for over 100 years. In an attempt to understand learning, early psychologists broke the processes down into simpler components, in much the same way that physicists studied the nature of matter by breaking it down into smaller components such as molecules and atoms.

One of the earliest theories of learning was based on the concept of **association**. Association, that is, relating two different stimuli or events in the environment, may represent the simplest type of learning. Associative learning can be broken down into two types: classical conditioning and operant conditioning. According to the associative theory of learning, **classical conditioning** is learning that results from the association of two stimuli in the environment. For example, at a very young age a baby learns to associate the smell of its mother with food. Because of this association, a hungry baby will often stop crying when its mother picks it up. **Operant conditioning** is defined as learning that occurs when an organism learns to associate its behavior with the consequence, or results, of that behavior. A dog learns that shaking hands, a behavior, produce a dog biscuit, the consequence of the behavior. Similarly, a college student learns that working hard usually produces good grades, and a politician learns that promising to lower taxes and increase services often produce votes.

Psychologists now recognize that certain types of learning may involve more complex processes. These complex processes are called cognitive processes and include memory, thinking, and reasoning.

1. Classical Conditioning

In the early 1900s, the Russian physiologist Ivan Pavlov began a series of experiments that have had a lasting influence on the way psychologists view the learning process. Pavlov's experiments were the first systematic study of the simple type of learning that came to be labeled as classical conditioning.

Pavlov was not interested in studying learning when he began his research. Instead, he was studying the physiology of the dog's digestive system, a line of research that had already earned him the Nobel Prize in medicine and physiology.

As part of his experiments, Pavlov caused dogs to salivate by placing meat powder in their mouths. In the course of these studies, he noticed a remarkable phenomenon. The meat powder was not the only stimulus that caused the dogs to salivate. Stimuli that came just before the dogs received the meat powder, such as the sight of the food dish, also produced salivation. Pavlov recognized the importance of this accidental discovery. He reasoned that the dogs had learned to associate the sight of the dish with the delivery of the meat powder. With this in mind, Pavlov set aside his work on digestion and devoted full effort the study of this phenomenon.

Pavlov's Experiments

To measure accurately how much dog salivated, Pavlov performed a minor operation in which he implanted a small tube inside the dog's mouth near its salivary glands and then passed the tube through its check. Whenever the dog salivated, the saliva ran through the tube and was collected outside the dog's mouth.

As before, Pavlov found that whenever he placed meat powder in the dog's mouth, the dog salivated. Pavlov recognized that this response

to the meat powder was simply a reflex. **A reflex** is a specific and involuntary response to a stimulus and does not require any learning. To reflect the nature of this response, Pavlov named the dog's natural response to a stimulus-salivating in the presence of meat powder-the unlearned or unconditioned response (UR). The stimulus that produced the unlearned response was termed the unconditioned stimulus (US).

Next, Pavlov placed the animal in the apparatus. Once the animal was in place, Pavlov rang a bell. The bell was a neutral stimulus, since it did not produce salivation.

Pavlov then began to condition the dog to associate the bell with the meat powder by first ringing the bell and then presenting the meat powder. Each time the bell and meat powder were presented together, or paired, one trial occurred.

After about 12 trails, Pavlov simply rang the bell and did not present any meat powder. This time, the previously neutral bell caused the dog to salivate. Because the dog had learned to salivate in response to the bell, Pavlov called the bell the learned or conditioned stimulus. Salivation in this instance was called a conditioned response. In classical conditioning, the **conditioned stimulus** is the neutral stimulus that is paired with the unconditioned stimulus and eventually comes to elicit the conditioned response (CR). The conditioned response (CR) is the response that results from the pairing of the CS with the US.

To appreciate how classical conditioning might enter into a human learning situation, imagine you had a friend who had the habit of greeting you with a loud "hello" and then slapping you hard on the back. Whenever your friend slapped you (the US) you would reflexively flinch. After a number of trails-pairing the "hello" with the slap-you would probably flinch just from hearing your friend say "hello". In this instance, "hello" became the CS and flinching to "hello" became the CR.

PROCESSES IN CLASSICAL CONDITIONING

In Pavlov's simple experiment, the dog acquired a conditioned response. Acquisition, or learning of a new response, is one of the five major processes that can occur during classical conditioning. The others are extinction, spontaneous recovery, generalization, and discrimination.

[A] ACQUISITION OF THE CONDITIONED RESPONSE

One important goal of classical conditioning is to determine how many pairings or trails are necessary for the organism to acquire to acquire the CR. One general statement we can make is that the CR is acquired gradually. During the first few pairings of the CS and the US, there is not CR. After additional trails the CR begins to occur and, as the number of trails increases, the CR continues to strengthen until it reaches a maximum level.

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A second important aspect of the acquisition process is the time relationship between the CS and the US. For optimal conditioning, should the CS be presented before, at the same time, or perhaps after the US? In Pavlov's experiments, the bell (CS) rang and continued to ring until the meat powder (US) was delivered. This is called **delay conditioning**, because the offset of the CS is delayed at least until onset of the US, when two stimuli overlap and typically end at the same time. This is called **simultaneous conditioning**, because the CS and US begin and end at the same time. In other experiments, the bell came on and went off, and then a fixed time interval elapsed before the meat powder was delivered. Pavlov called this **trace conditioning**, a form of classical conditioning in which there is a fixed period of time between offset of the CS and onset of the US.

In delay, simultaneous, and trace conditioning, the CS occurs either before or at the same time as the US. Thus, they are all types of forward classical conditioning. In backward conditioning the US is presented before the CS.

Which produces the best conditioning? Of the three types of forward conditioning, delay conditioning is generally best, followed by trace conditioning, with simultaneous conditioning being the least reliable. Backward conditioning has worked in some cases but is generally unsuccessful.

[b]Generalization

Once an animal has been conditioned to give a CR in the presence of a particular CS, other stimuli similar to the original CS will also produce the same CR. In Pavlov's experiment, for example, if dogs were conditioned to salivate in response to a bell with a middle-C tone, thy would also salivate in response to bells with tones above and below middle C. Through this process of generalization, stimuli similar to the original Cs also evoke the CR.

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Generalization is an important process in human behavior. For example, ambulances use a variety of sirens to warn other drivers and pedestrians of their approach. Despite the variety, we come to associate the sirens with the approach of an ambulance. Of course, if any siren is too different, we might not readily associate it with an approaching ambulance. Another form of generalization occurs whenever we listen to the music accompanying a film. The music may be slightly different from film to film, but we soon learn to associate certain rhythms and instruments with danger or romance. Thus, generalization allows us to extend already existing associations to new situations, as long as the stimuli do not chance too much.

[c] DISCRIMINATION

Although generalization is an extremely useful process, it is not always beneficial and may even be harmful in some situations. Consider the young child who is frightened by a large, barking dog. Such a child might generalize and fear all dogs. Similarly, a young child who is startled by a man with a beard might generalize and fear all men with beards-even if one of them is Santa Claus. In such situations, the child must learn to distinguish between similar stimuli. This is discrimination, a process in which the organism learns to respond to certain stimuli but not to others. If Pavlov wanted his dogs to respond to the original middle-C tone only, he would have had to give them discrimination training. In this process the original middle-c tone only, he would have had to give them discrimination training. In this process the original middle-c tone (CS) is paired with the meat powder (US) until the CR is well established. Next, other CSs above and below middle C are presented but never followed by the meat powder. Initially the animal responds, or generalizes, to the similar CSs. But as training continues, the animal gradually learns that only the middle-C tone predicts food and gives the CR only when this stimulus occurs. At this point, the animal is said to show discrimination. Generalization and discrimination are sometimes thought of as opposite sides of the same coin. Generalization is a reaction to similarities, and discrimination is a reaction to differences.

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[D] Extinction and Spontaneous Recovery

Classical, conditioning, like most others forms of learning, is adaptive. Salivating in response of a CS that consistently predicts food may help an organism prepare to chew and digest the food. But if the environment changes, it is just as important for the organism to unlearn the association between the CS and the US. If the bell had ceased to signal meat powder for Pavlov's dogs, it would not have been to the dog's advantage to continue to salivate in response to the bell.

Thus, just as organisms learn to salivate in response to bell, they also learn to stop salivating when the bell no longer signals food. In this process of **extinction,** the CR gradually disappears when the US is removed. Pavlov's dogs stopped salivating in response to the bell after it was presented a number of times without any meat powder.

Extinction, like acquisition, is a gradual process. Each time the bell (CS) is presented and not followed by the meat powder (US), the strength of the CR, or the amount of salivation, decreases. After five extinction trials, the strength of the CR is cut about in half.

Responses will rarely completely extinguish after one extinction session (a series of extinction trials). Usually, a number of these sessions are necessary to completely eliminate the CR. But as these sessions progress, we encounter a phenomenon called **spontaneous recovery,** a process in which the CR recurs after apparent extinction.

After the first daily extinction session, the animal is returned to its home cage overnight and then put back into the conditioning apparatus for a second extinction session the next day. The strength of the CR at the beginning of Day 2 is actually greater than it was at the end of Day 1.this happens even though the animal has received no additional CS-US pairings in the meantime. This increased response at the beginning of Day 2 is the spontaneous recovery. As extinction trials continue on Day 2, the strength of the CR will again decrease, but it usually takes many extinction sessions before spontaneous recovery no longer occurs and the response is completely extinguished.

CLASSICAL CONDITIONING AND HUMAN BEHAVIOR

Psychologists have demonstrated that classical conditioning is a widespread phenomenon that can be produced in both animals and

humans, including infants. There are even reports of classical conditioning in simple organisms such as fish, snails and garden slugs.

Since stimuli are often paired in day-to-day experiences, the potential for classical conditioning is high. For example, the sound of a dentist's drill (the CS) makes many people nervous the (CR), probably because it has been associated with pain (the US). In fact research suggests that the sound of the dentist's drill is actually more unpleasant than the drilling itself.

The producers of horror movies also recognize the effects of classical conditioning. In this case, a gruesome event is frequently preceded by a theme song (you may remember the music that signaled the coming of the shark in the movie *Jaws*). If we consider the gruesome event as the US and our reaction to this event, perhaps fear, as the UR, then pairing the previously neutral music, the CS, with the gruesome event (US) will lead to classical conditioning. We know this has occurred when the music alone (CS) now makes us fearful, the CR.

Experimental evidence also supports the idea that fear can be learned through classical conditioning. The first and most famous demonstration of this phenomenon was conducted by John B. Watson and Rosalie Rayner is 1920. In this study, a 9-month-old boy, "Little Albert," was conditioned began, the researchers established two important facts. First, they determined that Albert was not initially afraid of the rat, since he would play furry creature. Second, they determined that Albert *was* afraid of a loud clang produced by hitting a bar with a hammer, since the noise caused Albert to cry and crawl away.

To condition Albert, the researchers paired the white rat (CS) with the loud noise (US). Each time Albert touched the rat, the researchers struck the bar with the hammer. After seven pairings, Albert cried whenever the rat was presented. According to Albert had learned to fear rats. Later in their study, Watson and Rayner, Watson and Rayner

demonstrated that Albert's fear of the rat generalized to other similar stimuli by showing that the sight of other animals, such as a rabbit or a dog, also made Albert cry.

The researchers reported that they had hoped to use conditioning techniques to extinguish Albert's fears but were denied the opportunity when Albert's mother removed him from the study before the final part of the experiment could be carried out. We shall see, that other psychologists did eventually develop conditioning techniques for helping patients "unlearn" the extreme fears called *phobias*.

Classical conditioning has a number of others applications in human behavior. One of these is its use in the treatment of addiction. One common from of addiction is drinking. When we consider drinking in the context of classical conditioning, alcohol can be identified as the US, which in turn produces the UR of a pleasurable physiological effect. Next we need to identify the CS. The stimulus that most reliably precedes the physiological effects of alcohol is the liquor's taste. Most people would agree that the taste of liquor is not naturally pleasant, but perhaps when paired with the pleasant physiological effects of the alcohol, the taste too becomes pleasant.

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Once we have analyzed drinking in terms of classical conditioning, how can this information be used to help the problem drinker? One way to eliminate a classically conditioned response is to present the CS without the US-the procedure called extinction. In this case, we would present liquor, the CS, that contained no alcohol, the US. While this procedure could work in principle, there are several practical problems. First, it is difficult to produce a substance that taste like liquor but contains no alcohol. A second problem is that extinction takes many trials and is accompanied by spontaneous recovery. Thus, for practical reasons, a procedure more powerful than extinction is necessary. One such procedure is called ***counter conditioning.***

In counterconditioning, rather than presenting the CS with no US, we present the CS and pair it with a new US. The new US must be more powerful than the original one in order to eventually replace it. When the CR to the new US is incompatible with the CR to the old US, the old CR –in this case drinking –stop. Let's consider exactly how this procedure might work.

One technique that has been used to help problem drinkers is to use the taste of alcohol as the CS and pair it with a drug that produces nausea and vomiting. After several pairings, liquor no longer produces a pleasurable, sensation but instead producer nausea. In one such case a 63-year-old alcoholic underwent treatment for one month. Twice each day he drank an alcoholic beverage and then received an injection of a drug that made him nauseated. The treatment was successful, and 3 years after the treatment ended he still had not taken a drink.

Unfortunately, not all reported cases are this successful. In many instances the reduction in drinking is only temporary. This is not surprising since in the natural environment the taste of liquor is no longer paired with nausea; thus, extinction will occur. Nevertheless, when classical conditioning procedures are combined with other procedures to help the problem drinker, they can be effective.

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CONTRIBUTIONS AND LIMITATIONS OF CLASSICAL CONDITIONING

Classical conditioning is a simple form of associative learning that helps the organism adapt to its environment. It occurs in a variety of species and situations and has a number of applications in human behavior, such as in the acquisition of certain fears and the treatment of addictions. But can classical conditioning explain all types of simple learning? Consider the following example.

One trick that almost all pet dogs can learn is “shaking hands.” This is a relatively simple tick that dogs can often acquire with very little training. To teach this trick through classical conditioning, we would begin with a US that is capable of producing the desired response of shaking hands. But what is the US that reflexively causes a dog to shake hands? There is none. Shaking hands is no US, the dog cannot learn to shake hands through classical conditioning. It is clear, therefore, that classical conditioning cannot account for all learning. To understand how a dog learns to shake hands on command, as well as how a number of other behaviors are learned, we will have to examine a second type of learning *called operant conditioning.*

2. Operant Conditioning

This basic assumption of operant conditioning is that behavior is influenced by its consequence. A dog will learn to shake hands if a certain consequence, such as getting food, follows the response. Similarly, a seal can learn to balance a ball on its nose if the consequence of this behavior is receiving a fish, and a child might learn to clean up his or her room if doing so produces a trip to the ice cream parlor. B.F. Skinner coined the term operant conditioning to describe this type of learning because the organism produces a consequence by operating on its environment.

There are two important distinction between classical and operant conditioning. The first distinction concerns the organism’s control over the situation. In classical conditioning, the organism has no control over the situation. For Pavlov’s dogs, the meat powder (US) always followed the bell (CS). The dog did not have to give CR of salivating to receive food. On the other hand, in operant conditioning the organism’s behavior determines the outcome of the situation. The dog will receive food only if it shakes hands. Because of this, some psychologists prefer the term **instrumental conditioning** over operant conditioning, indicating the organism’s response is instrumental in determining the response’ consequence. We will use the term

operant conditioning throughout this chapter, but it is important to keep in mind that the two terms can be used interchangeably.

The second distinction between classical and operant conditioning involves the type of response that can be conditioned. In classical conditioning, responses are limited to reflexes, or automatic responses to specific stimuli. As we saw in the example of a dog learning to shake hands, unless there is a preexisting US that automatically produces a UR, classical conditioning cannot occur. In operant conditioning, responses are not limited to reflexes but include an entire array of voluntary behaviors. For example, a young child in a playpen can exhibit any of a number of different behaviors. The child can smile, crawl, stand up, or cry, to mention a few. Which of these behaviors will occur most frequently? According to the basic principle of operant conditioning, the behavior that occurs most frequently is the one that produces a positive consequences. If the baby's parents always hug the child whenever she smiles, the baby will probably smile a great deal.

At first glance, operant conditioning appears straightforward and perhaps even simpleminded. It is no surprise that people perform certain acts because these acts produce positive consequences. But simple as it may appear, operant conditioning may explain how a good deal of behavior is learned. In this section we will explore the basic principles of operant conditioning and then see how they apply to certain types of human behavior.

THORNDIKE' PUZZLE BOX

At about the same time Pavlov's was conducting his classical conditioning experiments, an American named E.L., Thorndike was carrying out a related set of experiments on cats. Throndike was greatly influenced by Darwin's theory of evolution and his ideas about animal intelligence. In an effort to understand how animals learn to adapt to their environment, Thorndike decided to study, in a

controlled laboratory setting, a form of learning that an animal might also use in its natural environment. To accomplish this, Throndike studied how hungry cats learn to escape from a “puzzle box” in order to get food.

Thorndike placed hungry cats inside a wooden puzzle box like. To escape from the box and get a piece of fish, the cat had to learn to open a latch inside the box. During the first trial, the animal explored, sniffed, clawed, meowed, and howled. Eventually, the cat accidentally tripped the latch, opened the door, got out of the box, and ate the fish. The next time the cat was placed in the box it exhibited many of the same behaviors but tool less time to escape from the box and get the food. After several additional trails, the cat immediately opened the latch to get the food.

Thorndike reasoned that responses such as exploring and clawing at the walls, which did not lead to a satisfying consequence were “stamped out,” whereas the behavior of opening the latch was “stamped in” by the resulting satisfaction. Based on these experiments, Thorndike proposed the **law of effect**, which states that acts followed by satisfying of state affairs are more likely to recur than acts followed by an annoying state of affairs. In the case of Thorndike’s cat, since opening the latch led to the satisfying state of eating, the behavior occurred more frequently. With these experiments, Thorndike had paved the way for operant conditioning.

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THE CONSEQUENCES OF BEHAVIOR

Although Thorndike is given credit for the first laboratory studies of operant conditioning, B.F. Skinner’s work has provided the majority of what we know about this form of learning.

Skinner’s insight into the consequences of behavior are perhaps his most important contribution. Building on Thorndike’s law of effect,

Skinner noted that when a particular behavior is performed, it may have one of two general consequence: reinforcement or punishment. Skinner reasoned that reinforcement would increase the probability that a behavior would recur, while punishment would decrease the probability a behavior would recur.

To test this hypothesis, Skinner studied the behavior of rats in an operant chamber. An operant chamber is a small cage with a lever, often called a bar, protruding from one wall. Below the bar is a chute for delivering a food pellet. Operant chambers are typically used to study bar pressing behavior in rats. To determine how the consequences of bar pressing affected the animal's behavior. Skinner monitored the rate at which the rat pressed the bar.

Through his experiments, Skinner identified three specific consequences of behavior that would affect the rate at which the rat bar pressed: positive reinforcement, negative reinforcement, and punishment.

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(A) Positive Reinforcement

A **positive reinforce** is any stimulus whose presentation increase the probability that a behavior will occur. An excellent example is a rat bar pressing in an operant chamber for the presentation of food. Since bar pressing then occurs more often, we know that food is a positive reinforcer. **Positive reinforcement** is the procedure used to increase the probability of a response by following that response with a positive reinforcer.

The use of positive reinforcement to guide human behavior is quite prevalent. When a second-grader completes a homework assignment, the teacher gives the student a gold star as a positive reinforcer. When a corporate executive increases her productivity, the boss gives

her a bonus. When a gymnast successfully completes a difficult vault, the judges award him a high score.

(B) NEGATIVE REINFORCEMENT

A **negative reinforcer** is a stimulus whose removal increase the probability that a behavior will occur. A rat is placed in an operant chamber and a low-level shock is turned on. The shock is an unpleasant or aversive stimulus. When the animal presses the bar, the shock is terminated. Here, the behavior of bar pressing is followed by the removal of an aversive stimulus. Consequently, the frequency of bar pressing increase. **Negative reinforcement** is the procedure used to increase the probability of a response by removing an aversive stimulus after the response occurs. With positive reinforcement, the organism emits a behavior to obtain a reward. With negative reinforcement, the organism emits a behavior to secure relief from an aversive stimulus.

One common example of the use of negative reinforcement to increase a behavior in human is the seat-belt buzzer in a car. When we start a car without first fastening the seat belt, a loud, aversive buzzer sounds. To remove this aversive stimulus, we increase the behavior of putting on our seats belts. A child crying is another aversive stimulus; crying often increases the parent's behavior of picking the child up to stop the crying.

(C) PUNISHMENT

A **punisher** is a stimulus whose presentation *decreases* the probability that a behavior will occur. If a rat presses a bar and is shocked immediately afterward, the behavior of bar pressing will occur less often. The term for this process is **punishment,** defined as the procedure used to decrease the probability that a response will recur by presenting an aversive stimulus after the response. As you can see,

the effects of punishment are just the opposite of those of reinforcement. (Another type of punishment, called *negative punishment,* is defined as removal of a pleasant stimulus which has the effect of decreasing the probability of a behavior. For example, a teenager is grounded for staying out past curfew. The grounding, or removal of privileges [removal of a pleasant stimulus], has the effect of reducing the teen's behavior of staying out past curfew.)

The use of punishment to change human behavior is widespread. Prison, fines, and spankings are just a few common examples. But as we will see, the use of punishment to change human behavior also raises many questions. Graphic summaries of the differences between reinforcement and punishment are shown in shows the consequences of behavior that is reinforced or punished, and summarized the types of operant conditioning and the effect on behavior of each type.

PROCESSES IN OPERANT CONDITIONING

Many of the processes that occur in operant conditioning are similar to those occur in classical conditioning. For example, operantly conditioned responses show extinction, spontaneous recovery, generalization, and discrimination, as do classically conditioned responses. In operant conditioning, however, it is sometimes difficult to get an organism to make the first, reinforceable response. One solution to this problem is the process of shaping.

[A] Shaping

In operant conditioning, an experimenter must wait for a behavior to occur before it can be reinforced. But what happens if the behavior doesn't occur spontaneously? In this situation it becomes necessary to shape the behavior. **Shaping** involves reinforcing behaviors that are increasingly similar to the desired behavior until finally the desired

behavior occur. To illustrate the shaping process, let's see how it might be used to train a dog to ring a doorbell.

The first step would be to reinforce a spontaneous behavior that in some way is related to the desired behavior. For example, we might watch as the dog sniffed around the house and give the dog a reinforcer whenever it came within 20 feet of the doorbell. After only a few reinforcers, the dog would spend most of its time near the bell. We could then give the dog a reinforcer for coming within 10 feet of the bell, then for coming within 5, and then only for standing right next to the bell. Next, we could give the dog a reinforcer for holding its head up in the direction of the bell and then only for sniffing at the bell. Finally, we would give the dog a reinforcer for actually pushing the bell with its nose.

Training a rat to bar press is a very similar process. When a rat is placed in an operant chamber, it will explore, sniff, and groom, but it will rarely press the bar. Operant conditioners say that bar pressing has a *low baseline rate,* meaning it doesn't occur very often. To circumvent this problem, researchers use a shaping procedure. Initially, the rat is given a food pellet whenever it is in the same half of the cage as the bar. Next, the animal's behavior is reinforced only when the rat is within 2 inches of the bar, then only of touching the bra, and finally only for pressing the bar.

Shaping is such a common process in human learning that we may not even be aware of it. When we teach children to dress themselves, to ride a bicycle, or to read, we begin with simple, easily executed components and gradually build to the complete response.

[B] Extinction and Spontaneous Recovery

If a rat has learned to press a bar for food but the experimenter changes the situation so that a bar press no longer produces food, the

rat will eventually stop responding. As in classical conditioning, this extinction process occurs gradually. Also, a rat that has undergone an extinction session and has been returned to its home cage overnight will show spontaneous recovery when placed in the operant chamber the next day. That is, it will press the bar at a higher rate at the beginning of the second extinction session that at the end of the first.

Extinction of operantly conditioned responses can occur in a variety of situations. When parents no longer pick up a baby who throws a temper tantrum or when a teacher ignores children who show off in the classroom, they are allowing the behavior to occur without the resulting reinforcer. In each instance, the undesirable behavior will eventually be extinguished.

[C] GENERALIZATION AND DISCRIMINATION

As was the case in classical conditioning, generalization and discrimination are important aspect of operant conditioning. Once a rat that learns that pressing a bar will produce a food pellet, we can teach the rat to discriminate by changing the situation slightly. During discrimination, the animal learns that bar pressing will produce food only when certain stimuli are present. This is often done by sounding a particular tone. The rat will receive a food pellet for bar pressing only when the tone is on. Gradually, the rat learns to discriminate and will only bar press when it hears the tone. A **discriminative stimulus** is a stimulus that signals that a particular response will be reinforced.

What would not happen if the pitch of the tone changed? In this case, the rat would generalize and would press the bar in response to the new tone. As in classical conditioning, generalization of operantly conditioned responses has two important characteristics: (1) organisms will respond to stimuli that are different from the original stimulus; and (2) as stimuli becomes less similar to the original stimulus, the response decreases.

Generalizations and discrimination of operantly conditioned responses play an important role in human behavior. For example, even though we might have learned to drive in a 1986 Chevrolet, we can generalize this behavior to other, similar cars. In the case of discrimination, we quickly learn that many behaviors are reinforced only if they occur in the presence of a discriminative stimulus. Consider the case of third-grader who works only when the teacher (the discriminative stimulus) is watching.

Generalization and discrimination are sometimes referred to under the single title of *stimulus control,* indicating that certain stimuli often gain control over behavior. The third-grader's behavior of working is under the stimulus control of the teacher. Stimulus control is an important concept in understanding certain human behaviors. Consider the case of a person who cannot sleep, an insomniac. For most people, the stimulus of a bed signals sleep. Using terms form operant conditioning, we might say that the bed is the discriminative stimulus, sleep is the behavior, and being well-rested is the reinforcer. Insomniacs, however, often use their beds for a variety of activities other than sleeping. Turning their beds into a combination office, living room, and kitchen, some insomniacs eat, read, write, talk on the phone, and watch television there. In these case, the bed has lot its stimulus control over sleeping because it signals many other behaviors. Now when the person tries to sleep, all the other behaviors associated with the bed interfere. What is the solution to this problem? The insomniac should use the bed *only* for sleeping and do all the other activities elsewhere. Although insomnia has multiple causes, research has shown that the application of stimulus control can help.

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OPERANT CONDITIONING AND HUMAN BEHAVIOR

The principle of operant conditioning have probably had a greater impact outside the laboratory than any other field in psychology. Psychologists interested in operant conditioning have applied principles developed in the laboratory to a variety of situations

including the classroom, mental institutions, diet workshops, athletic fields, corporate headquarters, and prisons, to mention a few. Operant conditioning techniques have been used to increase productivity in the workplace, to help parents toilet train their children, and as well as see in chapter 17, even to help people learn to relax. In this section we will examine three of the more interesting application of operant conditioning.

In one particularly gratifying example, the application of operant conditioning procedures allowed a severely disabled person to lead a more productive life. Robert Foster was in a serious automobile accident that left him completely paralyzed from the neck down. As you might imagine, Foster had great difficulty with simple, everyday tasks and needed constant care. But since his accident, Foster has attained a good deal more independence due to small Capuchin monkey named Hellion and the application of operant conditioning procedures.

Mary Willard, a psychologist and former student of B.F. Skinner, used shaping, positive reinforcement, and discriminative stimuli to train Hellion to help Foster with everyday tasks such as turning lights on and off; opening, closing, and locking doors; fetching magazines; taking records out of their jackets and placing them on the turntable; and eating. To train Hellion to perform a complex task such as playing a record, Willard and Foster used a shaping procedure much like the one described to train a dog to ring a doorbell. Foster uses an optical pointer, a small laser beam that he operates with his mouth, to point to objects he wants Hellion to fetch. The optical pointer acts as a discriminative stimulus. Mounted to Foster's chair is a food dispenser that Foster also operates with his mouth. Whenever Hellion performs the proper behavior, Foster dispenses a food pellet to reinforce the behavior. Hellion has learned that she will receive a pellet only if she fetches what the beam is pointing.

A second application of operant conditioning principles involves teaching at the college level. In 1968, Fred Keller, another student of

B.F. Skinner, wrote an article that had an immediate impact on college and university teaching. The article, entitled “Goodbye Teacher,” introduced a method for applying operant conditioning principles to higher education. Keller noted that in the traditional college course, student work through material as a group. They hear lectures and take exams on a schedule set by the professor. Keller’s method, called the “Personalized System of Instruction” or “PSI”, took the traditional course and repackaged it to take advantages of the principles of reinforcement. The PSI method breaks the course down into many small units, each of which must be mastered by the student before he or she can move on to the next. Grades, are based not on the score attained on two or three exams, but rather on the number of units the student completes. Student study a unit and when they are ready, they take an exam on that unit. The exams can be taken at almost any time and are graded immediately after the student completes the test.

How is PSI an application of operant conditioning? Much like the rat bar pressing n the operant chamber, the student under the PSI plan can respond whenever he or she wants. Responding in this case is mastering a unit and taking an exam. When the exam is completed the student, like the rat, gets immediate feedback-the grade. A passing grade serve as a reinforcer and increases the behavior of mastering the next unit and taking an exam. Whether students learn more in the PSI plan than in traditional courses is somewhat controversial, but there is some evidence that they retain more information and that they enjoy this method of instruction.

Operant conditioning procedures have also been applied in the workplace. One well known example comes from the best-selling book One Minute Manger, by Ken Blanchard and Spencer Johnson. This book advised managers to use praise and constructive criticism in the workplace; in other words, to use the principle of positive reinforcement. The authors advised managers to: (1) set clear goals, (2) catch people doing something right, (3) praise them immediately in these situations. Although these principles seem remarkable simple, they prove to be very effective.

The Nature of Reinforcement

Reinforcement is the most important aspect of operant conditioning because it determines which behaviors will be increased. We will then examine the distinction between primary and conditioned reinforcer and see how reinforcement can be used to produce very complex sequences of behavior.

THE EXPERIMENTAL ANALYSIS OF BEHAVIOR

One way to determine whether a stimulus is a reinforcer or a punisher is to observe its effect on an organism's behavior. If the stimulus increases the frequency of a response, it is a reinforcer. If a stimulus decreases the frequency of a response, it is a punisher. The method used to determine the function of a stimulus by examining its effect on behavior is closely identified with the experimental analysis of behavior. The experimental analysis of behavior, a movement led by B.F. Skinner, studies conditioning by focusing only on observable changes in behavior. This approach is much different from using common sense to determine what is a punisher and what is a reinforcer. A case that was observed involving a third-grader named Wendy illustrates this point.

The teacher complained that Wendy spent too much time out of her seat, even though the teacher punished her for this behavior. In fact, the teacher reported that the more Wendy was punished, the more Wendy stayed out of her seat. The school psychologist decided to observe Wendy and found that the spent 80 percent of the time out of her seat. The psychologists also observed that the teacher punished Wendy by scolding her. At least the teacher meant this as punishment. But according to the experimental analysis of behavior, a punisher should decrease the frequency of the behavior that it follows. Thus, scolding was not a punisher at all. Indeed, since it actually increased the amount of time Wendy stayed out of her seat,

scolding fit the definition of a reinforcer? One possibility is scolding be a reinforcer? One possibility is that the scolding gave Wendy attention, often a powerful reinforcer.

To make Wendy stay in her seat, the psychologist instituted a program whereby the teacher ignored Wendy whenever she was out of her seat. Only when Wendy sat down would the teacher pay any attention to her. After three weeks of this program, Wendy was out of her seat only 20 percent of the time.

Thus, a punisher or reinforcer may not always be what it appears to be. The experimental analysis of behavior allows us to determine which stimuli are punishers and which are reinforcer by observing their effects on behavior.

PRIMARY AND CONDITIONED REINFORCERS

Some stimuli are called **primary reinforcer** because they are necessary for survival. But why are stimuli such as money, diplomas, trophies, and good grates also reinforcer? The answer to this question lies in the concept of conditioned reinforcement.

A **conditioned reinforcer** is a stimulus that becomes reinforcing when it is paired with a primary reinforcer. For this reason, conditioned reinforcers are sometimes called secondary reinforcers. If a light flashed each time a rat received a food pellet, the light would become a conditioned reinforcer. This is because the light was paired with the primary reinforcer of food. To determine if the light was now actually a reinforcer, we would see if the animal increased a particular behavior, perhaps pressing a bar, just to see the light. If so, we would then know that the light had become a conditioned reinforcer.

Conditioned reinforcement plays a central role in many human behaviors. Perhaps the most common conditioned reinforcer is money. A classic study by Wolfe demonstrated how money can take on reinforcing properties even for animals. In this study, chimps first learned that putting a coin in a slot would produce a grape. The coin was thus paired with the grape and became a conditioned reinforcer. Later, Wolfe found that he could get the chimps to perform several tasks, including lifting a lever, just to get a coin.

CHAINING

One of the most interesting application of the conditioned reinforcers is chaining. **Chaining** is a procedure in which operant conditioning techniques are used to produce a complex sequence of responses. This process is often used by animal trainers to teach an animal a complicated sequence, or chain, of behavior.

Consider the rat who performed the following sequence of behavior flawlessly. When a light went on the rat responded by climbing a wire mesh staircase. After reaching the platform it pushed down a bridge and crossed to another platform. It them climbed a tall ladder. Next, it pulled a string connected to a small cart, climbed inside and moved it along a track by treading a paddle wheel with its front paws. At the end of the ride, it climbed up a flight of stairs and squeezed through a tunnel leading to a small elevator. For the grand finale, the rat raised the Columbia University flag and lowered itself to ground level. This turned on a buzzer, and the rat then pressed a bar to obtain food.

How can a rat learn such a complex chain of behaviors? Although it look as if the entire tasks was learned at once, the animal has really learned a series of separate behaviors that are reinforced with conditioned reinforcers.

In chaining, the last behaviors in the chain are learned first. Thus, the rat first has to be shaped to bar press for a food pellet. Next the animal learn a simple discrimination: if the buzzer is on, a bar press will produce a food pellet; if it is off, a bar press will have no effect. After a few days of training, the rat learns to bar press only in the presence of the discriminative stimulus-the buzzer. Since the buzzer is always paired with the food, it takes on the properties of a conditioned reinforcer. At this stage, the rat will perform a task just to turn on the buzzer. The next task that the rats learn is pulling the string to lower the elevator and raise the flag. Now, since the string is paired with the buzzer and thus the food, it too becomes a conditioned reinforcer. We can now get the animal to exhibit a behavior just to get access to the string. By continuing in this way, we can train the animal to perform the sequence of behaviors .

SCHEDULES OF REINFORCEMENT

In a **continuous reinforcement schedule (CRF)**, a behavior is reinforced each time it occurs. Such a schedule is possible in the laboratory, but in situations outside the laboratory it is unusual for any behavior to be reinforced all the time. Studying is not always reinforced by a good grade and even the best basketball player does not score a basket every time he or she shoots. Nevertheless, these behaviors still persist. When a behavior is reinforced only part of the time, it is said to be on a **partial reinforcement** schedule (PRF).

Psychologist have identified two basic types of PRF schedules. In the first type, called ratio schedules, the reinforcer is delivered after the organism responds a certain number of times. In the second type, called **interval schedules**, the reinforcer is delivered after a certain interval of time has passed. One of the most important features of these different types of PRF schedules is that they produce different rates of responding. The effects of PRF schedules on behavior both in and out of the laboratory.

1. **Ratio Schedules**

There are two basic types of ratio schedules: fixed and variable. In a **fixed-ratio (FR)** schedule, the response must occur a specific number of times before the reinforcer is delivered. A rat on an FR-5 schedule would have to press the bar 5 times before a pellet would be delivered. On an FR-50 schedule, the rat would have to press 50 times for each pellet.

Fixed-ratio schedules can produce a lot of work for very little reinforcement. Pigeons will peck a disc up to 2000 times just to receive one reinforcer! Of course in these situations the animal doesn't start out on an FR-2000 schedule. This schedule is developed gradually by first training the animal on CRF and then slowly shifting to FR-5, FR-10 and so on.

Fixed ratio schedules are quite common outside the laboratory. One example is piecework. A worker who is paid 1 dollar each time he or she completes 20 transistors is on an FR-20 schedule.

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On a **variable-ratio (VR) schedule** the response must occur a certain number of times before a reinforcer will be delivered, but the number of responses required for each reinforcer will vary. A rat on a VR-5 schedule will receive a pellet, on the average, after every 5 bar presses. For example, the first reinforcer might come after 3 bar presses; the next, after 8 bar presses; the next, after 1 bar press; and the last one, after 8 bar presses. In all, the animal has received an average of 1 reinforcer for every 5 bar presses.

Perhaps the best example of a variable ratio schedule outside the laboratory is gambling. A slot machine may pay off an average of once every 100 times a dollar is deposited a VR-100 schedule (and no doubt the payoff is less than $100). But the gambler does not known when it will pay. It may pay off twice in a row and then not again for 200

trials. This, of course is much to the dismay of gamblers who try to beat the odds.

Both FR and VR schedules produce extremely high rates of behavior. In other words, responses such as bar pressing will occur in rapid succession on these schedules. However, if the ratio in an FR schedule is very high, the animal will pause after each reinforcer. Higher ratios produce longer pauses.

With VR schedules, the pause disappears. VR schedules produce the most rapid rates of responding. Rats will bar press hundreds of times per hour on these schedules, and human on the VR schedule of a slot machine will often deposit money at a furious rate.

2. Interval Schedules

In contrast to ratio schedules, which deliver reinforcers after a certain number of response, interval schedules deliver reinforcers for the first response after a certain period of time has passed. On a fixed-interval (FI) schedule, a reinforcer is delivered for the first response after a set period of time. A rat on an FI-30 schedule will only receive a reinforcer for responding after 30 seconds have elapsed. If the rat were to respond 500 times during the 30-second period, it would take no difference. Only the first response after the end of the 30-second period would be reinforced. Then, a new cycle would begin. In this situation, the most efficient strategy would be for the rat of wait-30 seconds, give one response, get the reinforcer, and wait another 30 seconds.

This is exactly what a well-trained rat will do. Once a trained rat has learned an FI schedule, it will wait after each reinforcer is delivered. The animal appears to have learned that responses given immediately after a reinforcer will not be reinforced. As the end of the interval approaches, however, the rat again begins to bar press and will

continue to do so until it receives the next food pellet. When this pattern of responding in bursts is graphed, it produces a "scalloped" curve.

On a **variable interval (VI) schedule** a reinforcer is delivered for the first response after a period of time, but the time period varies. A rat on a VI-30 schedule will receive a reinforcer for bar pressing on an average of once every 30 seconds. For example, a bar press might produce a food pellet only after 15 seconds have elapsed. The rat might then not receive a pellet for bar pressing until 30 second have elapsed and then not until 45 seconds have elapsed. This would add up to a total of three reinforcer in 90 seconds, for an average of one reinforcer every 30 seconds. These unpredictable VI schedules produce more steady rates of responding than FI schedules.

(C) The Partial Reinforcement Effect

The **partial reinforcement** effect states that behaviors that are reinforced only part of the time take longer to extinguish than behaviors that are reinforced continuously. In a typical experiment, one rat is placed in an operant chamber and given a food pellet each time it bar presses. This is continuous reinforcement. A second rat is reinforced only some of the time that it bar presses, perhaps offer every tenth bar press-an example of partial reinforcement. When both animals are placed on extinction, the experimenters measure how many times each rat will bar press before ceasing to respond. The results how that the animal that was partially reinforced will bar press many more times.

The partial reinforcement effect has widespread implications for human behavior. Consider parents who reinforce their child's temper tantrums by paying attention to the behavior only some of the time as opposed to parents who reinforce the child's tantrums all of the time. The child who has only been partially reinforced will be very

persistent in these tantrums even when the parents try to extinguish this behavior by completely ignoring it.

Why does the partial reinforcement effect occur? There are many explanations. The most generally accepted one state that when an organism undergoes continuous reinforcement and is then placed on extinction, it is made immediately aware of the changed situation and that its behavior will no longer be reinforced. When an organisms has been on a partial reinforcement schedule, however, and is then switched to extinction, it is not immediately aware that the situation has changed. After all, it has already had some experience with its behavior not being reinforced. The gambler playing a broken slot machine may put in dozens of coins before realizing that the machine is no longer working. But the same gambler would probably only put one quarter into a broken coffee machine because he or she expects the machine to deliver a cup of coffee each time a coin is deposited.

SUPERSTITIOUS BEHAVIOR

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To now, we have discussing schedules of reinforcement in which a reinforcer is delivered whenever a behavior occurs. But what happens if reinforcer are delivered at random, independent of what the organism is doing? This is exactly the question that B.F. Skinner asked in a now-classical set of experiments. Skinner placed 8 pigeons in operant chambers set to deliver food every 15 seconds no matter what the pigeon was doing. Pigeons are active birds, so each was doing something when the food was delivered. And it was this "something" that was reinforced. Apparently, the birds associated their behavior immediately prior to being fed with the delivery of the food. Even though the behavior was reinforced completely by chance, the frequency of the behavior-whatever it happened to be-increased. Thus when Skinner observed his pigeons, he found that one was swinging its head forward and back, and another was turning in counter clockwise circles. Skinner argues that this accidental reinforcement could account for many superstitious behaviors.

Some of the most interesting example of superstitious behaviors come from athletes. For instance, we have all heard of basketball players who always bounce the ball three times before taking a free throw, baseball player who always tap the bat on the plate twice, and coaches who always wear their lucky sweater to important games. One study indicated that one third of college athletes admitted to having superstitions. Some cases of superstitious behavior can become quite elaborate. One example is Boston Bruin's hockey player Phil Esposito. Before each home game Esposito drove to the game wearing a black tie. He always passed through the same toll booth that he had gone through before his last winning game. When he arrived at the locker room, he put on the same black turtleneck that he had worn years before in a game in which he had been the highest scorer. He then put on his gear in exactly the same order; underwear, pants, skates, laces. He then placed a pack of gum plus one sick next to him and arranged his equipment in a precisely predetermined order. During the national anthem he always said a Hail Mary and the Lord's Prayer. Only after he had completed this incredible ritual was he ready to start the game.

What might superstitious behavior such as Esposito's have to do with Skinner's pigeons? According to Skinner, when an athlete is reinforced for a particular behavior, the frequency of that behavior increases. A baseball player who strikes the bat on the left-hand corner of the plate three times and then hits a home run in more likely to perform this same behavior during the next time at bat. Despite performing these same behaviors, however, the baseball player does not hit a home run on every at bat. So why don't these superstitious behavior extinguish? Recall the previous section on the partial reinforcement effect. As we stated there, behaviors that are partially reinforced are most resistant to extinction.

THE USE OF NEGATIVE REINFORCEMENT

So far, our discussion of operant conditioning has focused on the effects of positive reinforcement. As we indicated earlier, negative reinforcement also increase the frequency of behavior but, unlike positive reinforcement, uses an aversive or unpleasant stimulus, such

as shock, to accomplish this. Two example of negative reinforcement are escape learning and avoidance learning.

1. Escape Learning

Another name for operant conditioning with negative reinforcement is escape learning. In **escape learning** an organism increases a particular behavior to terminate or escape from an aversive stimulus. We escape from a cold house by putting more wood on the fire. In this instance, cold is the aversive stimulus and the behavior we increase is putting wood on the fire.

In the laboratory, escape learning is generally studied by means of a two-way shuttle box. Developed by O. H. Mowrer and Neil Miller in the 1940s, the shuttle box consists of two identical compartments that are separated by an opening just large enough for a rat to fit through. The bottom of each compartment consists of closely spaced metal rods that are used to deliver shock. The rat is placed in one compartment and a short time later a shock is presented. The rat can escape the shock is presented. The rat can escape the shock by running (shutting) to the opposite compartment. In keeping with the definition of negative reinforcement, the animal increases the behavior of running in order to escape the aversive stimulus of shock.

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2. Avoidance Learning

Avoidance learning is similar to escape learning, except that the organism doesn't simply escape but learns to avoid the aversive stimulus completely. In **avoidance learning** a warning stimulus signals an aversive stimulus, and the organism learns to avoid the aversive stimulus by emitting the appropriate response to the warning stimulus. Avoidance learning can be demonstrated in the lab by making a small alteration in the escape-learning procedure. The modification consists of presenting a warning stimulus, usually a tone, 5seconds before the shock occurs. During the first few tone-shock presentation, the animal exhibits escape learning; that is, it shuttles to the opposite compartment after the shock occurs. But after a number

of trials, an interesting change occurs. The animal learns that the tone predicts the shock and avoids the shock altogether by shuttling to the opposite compartment when it hears the tone.

Humans show avoidance learning in many situations. For example, have you ever known people whose behavior you simply could not tolerate? Such people might be so unpleasant that whenever you speak with them you expect to be either insulted or embarrassed. After several encounters with such people, you might go the other way whenever you see them. That is, you avoid them. In terms of avoidance learning, the behavior of these people is the aversive stimulus (like the shock), and the sight of them or the sound of their voice is the warning stimulus.

One explanation of avoidance learning is the **two-process theory,** which states that both classical and operant conditioning are involved in avoidance learning. According to this theory, the animal initially develops a fear response to the stimulus of the tone. This response occurs through classical conditioning as illustrated in.

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Once this occurs, the animal becomes fearful whenever the tone is presented. Then, the operant conditioning phase beings. The unpleasant state of fear acts as an aversive stimulus and the animal increases a behavior, such as shuttling to the opposite compartment, to escape the fear. This response reduces the fear since shuttling terminates the fear-producing tone. It also allows the animal to avoid the shock.

THE USE OF PUNISHMENT

Both positive and negative reinforcement are used to increase the frequency of behavior. Punishment, on the other hand, is used to decrease the frequency of a behavior. When a punishing stimulus follows a behavior, that behavior is less likely to occur again.

The use of punishment is quite prevalent in our society. It is very much a part of our legal system and is frequently used by schools and parents to eliminate certain behaviors in children. Because of its frequent use, understanding the effects of punishment on learning is as important as understanding the effects of reinforcement.

Skinner originally though that punishment was not effective and that positive reinforcement was a superior way to control behavior. But psychologists now know that, under certain circumstances, punishment can be an effective means of decreasing the frequency of particular behaviors.

In this section we will first examine what laboratory experiments have shown about the use of punishment and then discuss whether it is possible to apply these research results to human behavior.

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Laboratory Experiments on Punishment

Most of what psychologists know about punishment is based on studies conducted in the laboratory. In a typical experiment rats are first trained to press a bar in order obtain food. Once they are pressing at a steady rate, they are punished with a shock each time they press the bar. To determine how effective the punisher is, the experimenter monitors how quickly the rats stop pressing the bar. Experiments like this have enabled psychologists to formulate several guidelines that must be followed if punishment is to be effective. Keep in mind that this does not mean that psychologists advocate the use of punishment. Rather, they recognized that since punishment is often used, it is important to know exactly under which conditions it will work.

1. The punishing stimulus must be as intense as possible. This often limits the effectiveness of punishment because it is unethical to use intense punishers. One alternative to delivering a harsh punishment is to punish the response initially with a mildly aversive stimulus and to keep raising the intensity of the stimulus until the undesirable behavior decreases. Unfortunately, this method is not effective. Laboratory experiments have shown that if rats are shocked at a low level, they adapt to the shock and it has little effect on their behavior. As the shock level is gradually increased, the rats continue to adapt to the aversive stimulus until even high shock levels have no effect on behavior. But if a high shock level is used from the outset, the behavior is suppressed. Thus it actually may be more humane to use an intense punisher on eliminated, and the organism receives no further punishment.

2. The stimulus should immediately follow the behavior. Just as in the use of a reinforcer, a punisher is most effective when it immediately follows the behavior. For example, mothers who attempt to punish their misbehaving children by saying, "Wait until your father gets home, then you'll get it," may not be very successful in improving their children's behavior. Similarly, the "punishment" for eating calorie-rich foods, excess weight, is usually not immediately apparent. What would happen if a piece of a chocolate layer cake produced an immediate bulge in your stomach!

3. An alternative response should be provided. This last guideline is perhaps the most important. If we want to stop a dog from urinating in the house, we could punish the behavior, but this would not eliminate it unless we provided the dog with another place to urinate. Typically, this involves teaching the dog to urinate outside. In fact, the most successful method for house-breaking a dog is to punish urinating in the house and reinforce urinating outside. This guideline indicates that punishment is most effective when as undesirable behavior is punished *and* a desirable behavior is reinforced.

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In summary, punishment can be an effective way to eliminate undesirable behavior; however, to be effective, punishment must be intense, immediate, and an alternative behavior must be positively reinforced.

PUNISHMENT AND HUMAN BEHAVIOR

Should punishment ever be used to decrease the occurrence of certain undesirable behaviors in human? This is certainly a difficult ethical issue. Psychologists do not advocate the indiscriminate use of punishment, although in some cases the use of punishment has been justified. It is important to note that two conditions were present in most of these cases. First, efforts to use positive reinforcement had failed. Second, the behavior that was to be punished was more

dangerous than the punishment. In addition, the subject or someone responsible for the subject's welfare gave permission to use punishment techniques in each instance.

Among the applications of punishment is the use of electrical shock to help eliminate excessive alcohol consumption and to treat certain forms of sexual deviation. Punishment has even been used to help people stop smoking. One of the most interesting and successful uses of punishment has dealt with self-injurious behavior in autistic children.

Childhood autism is a serve psychological disorder. In some cases, autistic children will injure or mutilate themselves. In a pioneering study, Tate and Baroff (1966) worked with Sam, a 9-year-old autistic child. Tate and Baroff reported that Sam banged his head against the wall and other hard objects at a rate of up to seven times a minute. He also slapped and punched his face and kicked himself. In the hope of eliminating this dangerous behavior, Sam was first told about and then given a half-second electrical shock every time he hit himself. After several months of this therapy, Sam's self-injurious behavior was eliminated.

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As Sam's case indicates, even though punishment might be distasteful, it is often the best way to eliminate undesirable behaviors –especially when the behavior is more dangerous to the person than the punishment itself.

THE INTERACTION OF BIOLOGY AND CONDITIONING

The early work on both classical and operant conditioning suggested several rules that must be followed for effective conditioning to occur. for example, in classical conditioning the US must closely follow the CS. Presenting Pavlov's dogs with the meat powder (US) 10 minutes after the bell (CS) would never produce a CR. Similarly, in operant conditioning the behavior must be followed immediately by a

reinforcer or a punisher. Most researcher also believed that conditioning occurred gradually over many trails.

More recent research, however, indicates that an organism's natural, biological reaction to various aspects of the learning situation may determine how well the organism will learn the task. In this section we will first see that in certain situations, organisms learn associations very easily. Second, we will see that certain associations are impossible for some animals to learn. We will then took at what this has taught us about effective conditioning. Finally, we will examine how learning may be important in explaining an organism's behavior in its natural environment.

PREPAREDNESS AND TASTE-AVERSION LEARNING

Martin Seligman suggested that there are certain associations that organisms are best suited to make. He proposed that through natural selection, organisms have a built-in, genetic bias or preparedness that allows them to readily learn associations that have the greatest impact on their survival. To illustrate this point, let's examine one of the earliest experiments in this field, the taste-aversion studies conducted by John Garcia.

Garcia and his co-workers presented a thirsty rat with a saline solution and measured the amount the rat drank. Next, they exposed the animal to a high dose of X-rays, which made the animal quite nauseated, but not until 12 hours later. After the rat had recovered from the illness and was again thirsty, they presented the animal with the saline solution. This time the rat drank very little. Apparently, the animal had learned to associate the illness with the taste of the saline.

There are three important results of this study. First, taste aversion took place, even though there was a 12-hour delay between drinking the saline and feeling nauseated. Second, the association between the

saline and feeling ill was learned in one trial. A third significant factor was that only the taste of the saline water was associated with the illness. Even though many stimuli could have been associated with feeling ill. For example, the rats did not show any aversion to the place in which they became ill. These results suggest the existence of the built-in bias Seligman calls preparedness.

Garcia's work an taste-aversion learning has made an important contribution to the study of learning. Taste aversion also has had some rather interesting applications, such as in the control of coyotes who kill sheep. One of the most persistent problems facing a sheepherder is loss of sheep due to coyotes. Recently, sheepherders have been involved in a project in which they inject deep sheep with a toxic chemical. When a coyote eats the meat from the injected sheep, it becomes ill but does not die; in fact, it fully recovers within a few hours. But it nerve again touches sheep. Apparently, coyotes associate the taste of sheep with the illness, resulting in taste aversion to sheep. This solution seems to be an amicable one for both the sheepherder and the conservationist. It simultaneously allows the sheepherder to protect the sheep from the coyotes and avoids mass slaughter of the coyote.

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TASTE-AVERSION LEARNING IN HUMAN BEHAVIOR

Since the pioneering work of Garcia, researchers have identified a number of associations that animals seem prepared to make .one question still remains: do humans also show taste-aversion learning and other forms of preparedness?

Like the animals in Garcia's experiments who learned to associate the taste of certain foods with illness, many people have had the experience of eating at a restaurant, becoming sick to the stomach several hours later, and blaming the illness on something they had eaten. This suggests that humans experience taste-aversion learning. The results of an experiment to discover why cancer patients

undergoing chemotherapy often stop eating also indicate that humans experience taste aversion learning.

Many cancer patients regularly experience nausea and loss of appetite from chemotherapy. These patients often refuse to eat enough and thus lose weight and strength. As a result, they are more vulnerable to infections and other problems that complicate their recovery. Since this is such a severe problem, researchers have spent considerable effort trying to understand the processes underlying this loss of appetite. One promising approach suggests that the loss of appetite may be due a learned taste aversion.

A study by Ilene Bernstein demonstrated that children undergoing chemotherapy developed aversions to an unusual flavor of ice cream, Mapletoff (prepared with maple and black-walnut flavor extracts). The children in the experiment had eaten this ice cream shortly before the nausea-producing chemotherapeutic drugs were given. As Bernstein points out, the procedure of presenting a food with a nausea-producing of presenting a food with a nausea-producing drug in much like the procedure Garcia used to produce taste aversions in rats. The results found in human were much like those found in rats. Patients who ate Mapletoff and then became nauseated due to chemotherapy avoided the Mapletoff ice cream even though they knew that it was the chemotherapy and not the ice cream that it was the chemotherapy and not the ice cream that made them ill.

This findings does not appear to be limited to one unusual food. Other research has indicated that chemotherapy patients develop aversions to foods that are eaten up to several hours before treatment. These studies also support the idea that the loss of appetite in chemotherapy patients may in part be due to learned taste aversions. This work also suggests that it may be possible to minimize or eliminate this problem if proper procedures are used.

Do human also show preparedness for other types of learning? Some evidence indicates that humans may learn certain fears more readily than others. In one study, college students were shown pictures to snakes or to horse sand asked to rate them from 1 to 0 on a "discomfort" scale. Then the conditioning phase began. Half of the students saw a picture of a snake; this was followed by a mild shock. The rest of the students saw a picture of a horse; this, too, was followed by the shock. After the conditioning, the students were once again asked to rate the snakes and the horses on the discomfort scale. Interestingly, the discomfort rating went up for the snakes but did not change at all for the horses. This results suggests that the students were prepared to associate snakes, but not horses, with unpleasant events. The fact that a fear of snakes is quite common may be related to this preparedness.

A second area of human learning in which preparedness may be a factor is language. Many researchers argue that humans acquire language rapidly because there is a biological preparedness for learning this complex behavior.

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THE MISBEHAVIOR OF ORGANISMS

Just as an organism can learn to make certain associations very easily, other associations appear impossible for the organisms to learn. Two former associates of B.F. Skinner, Marion and Keller Breland, used their expertise in operant conditioning to train animals for television shows. But sometimes things did not work out as expected. In 1960 they wrote an article based on this work called "The Misbehavior of Organisms." What they meant by misbehavior was the failure of positive reinforcement to increase certain behaviors. Although this article was not a serious research paper, it offered for the first time evidence that not all behaviors can be controlled by reinforcement.

One of the examples of "misbehavior" the Brelands described was that of the miserly raccoon. The Brelands had tried to teach the raccoon to place a con in a piggy bank through positive reinforcement. However, some difficulty arose.

Raccoons condition readily, have good appetites, and this one was quite tame and an eager subject. We anticipated no trouble. Conditioning him to pick up the first coin was simple. We started out by reinforcing him for picking up a single coin. Then the container was introduced, wit the requirement that he drop the coin into the container. Here we ran into the first bit of difficulty: he seemed to have a great deal of trouble letting go the coin. He would rub it up against the inside of the container, pull it back out, and clutch it firmly for several seconds. However, he would finally turn it loose and receive his food reinforcement. Then the final contingency: we put him on a ratio of 2, requiring that he pick up both coins and put them in the container. Now the raccoon really had problems. Not only could he not let go of the coins, but he spend seconds, even minutes, rubbing them together, and dipping them into the container. He carried on this behavior to such an extent that the practical application we had in mind-a display featuring a raccoon putting money in a piggy bank-simply was not feasible. The rubbing behavior became worse and worse as time went on in spite of non-reinforcement.

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Why was it so difficult to train the raccoon to perform this task? The Brelands suggested it was due to instinctual drift, meaning that the animal's instinctual behavior interfered with learning the task. It in instinctual for raccoon to meticulously wash their food before eating it. Apparently, since the coins had been paired with food, much like a CR, the raccoon treated the coins like food. In the Breland's task, then, the instinctual behavior of washing the coin prevented the animal from depositing it in the slot. Under these circumstances, conditioning is difficult and sometimes impossible.

ETHOLOGY AND LEARNING

Ethologists are scientists who study the behavior of organisms in their natural environment rather than in a laboratory setting. In fact, research such as that on taste-aversion learning and the misbehavior of organisms has led ethologists to question the validity of using a laboratory setting for the psychological study of learning.

Ethologists argue that it is most beneficial to study how organisms learn in a natural environment where the organism's powerful natural biological reaction can occur. for example, in a natural setting, organisms can associate illness with the taste of polluted water even when the two are separated by several hours. But when this same association is studied in a laboratory setting, where the experimenter can control and CS and US so that they always occur within a second of each other, all aspects of the organism's natural power of association may not be brought out. For instance, the strict control in the laboratory would not allow for an "accident" that would show that even when the time between the CS and the US stretched to several hours, the association was still formed effectively. Therefore, ethologists hold that this learned association may have been found much sooner through research done in the natural controlled laboratory setting masks some of the phenomena that can occur during learning.

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Does this mean that the principles of classical and operant conditioning discovered in the laboratory may not operate in the real world? Some recent research provides an interesting insight into this issue.

Research by Karen Hollis has suggested that laboratory learning principle such as those derived from classical conditioning may be very valuable in the natural environment. To make this point Hollis has studied conditioning in tropical fish called blue goramies. The male of this species is very territorial and will attack any other male who enters its territory. In a classical conditioning experiment with these fish, Hollis paired a red light with a rival male. The purpose of

this was to elicit aggressive behavior in the male whenever it saw the red light. A control group did not receive these pairings. She then tested subjects from the two groups of fish in a natural environment. During testing, she placed a previously conditioned male in the tank-his territory. He was then shown a red light, immediately followed by the presentation of another male fish. Hollis found that fish that had undergone classical significantly more often than did the control fish.

According to Hollis, the red light for fish in the conditioning group allowed these fish to prepare better for the fight to come in the same way that salivation by Pavlov's dogs allowed them to prepare to digest the meat powder.

How does this research related to the debate between the ethologists and psychologists about how to study learning? Research such as Hollis' suggests that the principles of learning developed in the laboratory can operate in the natural environment and it is up to researchers from a variety of disciplines to determine exactly how laboratory learning principles might operate in the real world.

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Although researcher have been studying conditioning for nearly a century, they have only recently begun to recognize the importance of its biological aspects. An awareness of these biological influences should put psychologists in a better position to explain the very complex process of learning.

3. The Cognitive Approach to Learning

The focus of this chapter thus far has been the associative approach to conditioning. Its pioneering researchers, such as Pavlov and Throndike, believed that conditioning occurred in a very mechanistic way. When a response occurred in the presence of a particular stimulus and that response was reinforced, a stimulus-response (S-R) connection was formed. As the response was reinforced more and more, the S-R connection was "stamped in" until the behavior

became automatic. Thus, a rat that presses a bar or a dog that salivates is showing an automatic S-R pattern. This approach, sometimes referred to as the S-R approach to learning, has contributed much of what psychologists know about learning. But more recently, some psychologists have argued that this view may be too simplistic. These psychologists have adopted the cognitive approach to learning.

The cognitive approach to learning holds that learning is not simply an automatic process. Rather, the cognitive approach maintains that important cognitive, or mental, processes occur between the stimulus and the response.

One of the first proponents of the cognitive approach was Edward Tolman. Tolman proposed the cognitive view of learning as a reaction to Throndike's law of effect. According to Tolman, all organisms, including animals, are capable of thinking and this capacity must be considered in any explanation of learning. It is too simple to regard an organism like a vending machine-put in a stimulus and expect a response. Rather, psychologists must recognize that in learning the organism takes in information about its surroundings and attempts to use this information to adapt to its environment. This is true for all behaviors, even a seemingly simple one like a rat learning to bar press. The cognitive approach holds that it is important to examine these mental processes during conditioning.

To help appreciate the distinction between the S-R and cognitive approaches to learning, let's consider, a now-classic experiment conducted by O.L. Tinklepaugh in 1928. In this experiment, a monkey was allowed to observe Tinklepaugh place a banana under one of two cups. When the monkey was then allowed to select one of the cups, it selected the one hiding the banana. In the next phase of the experiment, the monkey again watched Tinklepaugh place the banana the under the cup. But this time, while the cups were out of the monkey's view, Tinklepaugh exchanged the banana for a piece of lettuce. When the monkey was allowed to choose, it selected the

correct cup. But when the monkey found lettuce instead of the banana, it showed surprise and frustration, rejected the lettuce, and began searching for the banana.

Using evidence such as this, Tolman argued that the monkey did not simply make an automatic connection between the stimulus and the response. Rather, its behavior was guided by cognitive processes such as memory and expectancy. That is, the monkey *remembered* that a banana was placed under the cup and *expected* to find it here.

Expectancy, the view that an organism comes to expect a reinforcer, has also been used to explain very simple forms of learning such as classical conditioning. For example, when Pavlov's dogs salivated at the sound of the bell, it was because they made an automatic connection between the bell and meat powder. Salivating was a way to prepare to eat the expected food.

In this section we will examine some of the other evidence that suggests a cognitive view of learning. We will begin with some of the very early work of Wolfgang Köhler who studied insight learning in chimps. We will then examine a phenomenon called observational learning, and we will conclude this section with some research that has far-ranging implication for human behavior, the phenomenon of learned helplessness.

1. Insight Learning in Chimps

Most of us have had the experience of studying a difficult problem for a long period of time with little progress toward the solution and then suddenly having an "aha" experience and realizing in a flash how to solve that math problem, fix your stereo, or finally get your computer program to run. Is this type of insightful learning unique to humans?

In the 1920s, German psychologists Wolfgang Köhler was on the island of Tenerife, off the west coast of Africa near the equator. Apparently Köhler was a German spy whose job was to monitor shipping. But Köhler was also a psychologist and while on Tenerife he decided to take advantage of the local population of primates to study insight learning in chimps. His results directly challenged the S-R view of Thorndike.

According to Thorndike's law of effect, intelligent behavior is the result of random train and error. A cat does not "figure out" how to escape from he puzzle box. Rather the cat produces a wide range of unintelligent behavior until it stumbles upon the one behavior until it stumbles upon the one behavior that allows it escape from the box. This behavior then is "stamped in." thus, Thorndike viewed learning as the automatic process of connecting the stimulus and the response. Köhler, however, had other ideas. He felt that at least sometimes the animal's behavior was intelligent right from the start.

To support his view, Köhler cataloged some examples of insight learning in the chimp. In one situation the chimps could see some tempting bananas above them, but the fruit was just out of reach. Köhler then distributed an assortment of boxes and sticks throughout the chimps play area. Kohler observed that a chimp might first try to reach the fruit by jumping at it. Eventually, the chimp would give up and begin pacing back and forth. Suddenly the pacing would stop. The chimp would then act quite purposively in a way that would allow it to obtain the bananas. One chimp gathered boxes and stacked them, then climbed them to obtain the fruit. Another chimp took two hollow bamboo sticks and made one long stick by inserting one into the other. He then used the stick to retrieve the banana. Yet another chimps used a box and a stick, climbing on the single box and using the stick to swat at the banana. It looked as though the chimps had thought about the problem and suddenly arrived at the solution.

Kohler took these findings as evidence that chimps, like humans, showed insight learning. More generally, findings of this type are taken as evidence of cognitive learning in animals.

2. Observational Learning

A second area of research suggesting evidence for a cognitive view of learning is observational learning. **Observational learning**, or modeling, as it is sometimes called, is learning that results from watching the behaviors of others and observing the consequences of that behavior. Research on observational learning question the S-R view of learning because in these situations, the learner neither directly experiences the stimuli nor makes the responses.

The fact that humans learn a great deal by watching others probably comes as on surprise. In a typical experiment to examine the effects of observational learning, the subject will watch another person, the model, respond to a certain situation in a particular way. Later, the subject will be put in the same situation and the experimenter will determine how much the subject imitates the models' behavior. Often, the behavior of the model will have a profound influence on the subject's behavior. In one study, children who had won money in a table bowling game had the opportunity to donate some of this money to the March of Dimes. Before playing the game, the children saw a television sequence in which a model either made a donation, while commenting that it is good to donate, or spoke against donating and gave no money. The children who saw the model donate contributed much more money.

Do animals learn by observation? There has been some controversy over this point. Thorndike was interested in determining if cats could learn to escape from a puzzle box by observing a previously trained cat perform the escape response. He was unable to show that any of his animals learned by observation. But other experimenters have

reported positive results. Kinnaman placed a monkey in a box from which it could escape by pulling out a plug that secured the lid. The monkey failed to work the mechanism and eventually gave up. Later, the unsuccessful monkey watched another monkey solve the problem by biting the end of the plug and pulling it out with his teeth. When the unsuccessful monkey was given another try, it solved the problem immediately. Following this study, many other experimenters have reported that animals, like humans, can learn by observation.

The researcher on observational learning has been very influential and has been applied to such diverse issues as how children may learn aggressive behavior from watching television and how to help people deal with phobias. For now, it is important to realize that observational learning does not support the view that all learning is simply an automatic S-R process. **See more in suppl***

3. Learned Helplessness

In our discussion of expectancy in Tinkle-paugh's monkeys we saw that when an organism expects a positive reinforcer does not get it, it can react with disappointment. But how does an organisms react when its behavior does not terminate an aversive stimulus as expected? The results in this situation is one of the most interesting phenomena in conditioning-the organism learns to be helpless. Let's first example the experiment in which this principle was discovered and then discuss its implications.

In the experiment, dogs were divided into three groups. One group underwent standard escape learning. The dogs were restrained in a hammock and given shocks to their hind legs. They could terminate the shock by pushing a button with their noses. Dogs in the second group, the helpless group, also were suspended in a harness and received shock to their hind legs but could not terminate the shock by pushing a button. Dogs in the third group, the control group, were placed in hammocks but did not receive shock.

In the second phase of the experiment, Sligman and Maier put each dog in a compartment of a two-way shuttle box and delivered shocks to the dog. As you might expect, dogs in the escape and control groups had no difficulty learning to run to the opposite compartment to escape the shock. But dogs in the helpless group never learned to shuttle to the opposite compartment.

The behavior of the preshocked dogs was bizarre. When they received the first shock in the shuttle box, they initially looked like the naïve; dogs they ran about frantically, howled, defecated, and urinated. However, unlike naïve dogs, they soon stopped running around and quietly whimpered until the train terminated. After a few trials, they seemed to “give up” and passively “accept” the shock. On later trials, these dogs failed to make any escape movement at all. A few dogs would get up and jump the barrier, escaping or avoiding shock; yet surprisingly, on the next trial such a dog would go back to taking shock. It did not seem to learn that barrier-jumping produced shock termination.

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Seligman and Maier reasoned that during the first state of the experiment, dogs in the helpless group learned that they had no control over their situation. No matter what they did, they could not escape the shock. Since these dogs had learned to be helpless they didn’t try to escape even when placed in a situation where escape was possible. **Learned helplessness** is the name given to this phenomenon whereby an organism does not attempt to escape an aversive stimulus after the organisms has previously been subjected to a similar, inescapable aversive stimulus.

Learned helplessness also occurs in humans. In one experiment, college volunteers were presented with an aversive stimulus in the form of a loud, unpleasant noise. They were told that they cold stop the noise by moving a control device. But actually these devices did

not control anything. Later, when the volunteers were placed in a situation in which moving a lever would stop the noise, the volunteers made no attempt to do so. Instead, they tolerated the noise until the experiment was over. Like the dogs, they had learned to be helpless.

The principle of learned helplessness shows that when organisms are placed in a situation over which they have no control, they develop the expectation that their behavior will not have any effect. This expectation then transfers to new situation where it may not be true.

COGNITIVE OR STIMULUS-RESPONSE LEARNING?

The research that we have described in this section question the S-R view of learning. Does this mean that the S-R theory is wrong and should be abandoned? Probably not. Rather than trying to call one theory right and the other wrong, it may be more fruitful to think of them as being complementary. Some forms of learning seem better explained by an S-R point of view, whereas other are better suited to the cognitive approach. Still others may require aspects of each. It is likely that we will need to use principles and theories from both points of view in order to understand the complexity of human learning.

For example, certain learned behaviors do seem very automatic. Consider driving a car. Most experienced drivers are able to perform this complex task while paying little or no attention to it. They respond automatically to stimuli such as green lights, stop signs, or children running into the street. Although cognitive processes may have come into play when these people first learned these reactions, the task now seem s very automatic. Now contrast this with trying to learn to write a computer program. In this instance the programmer must reason about many facts, rules, and complex relationship to be successful. It seems that cognitive processes play a large role here.

Nevertheless, as the programmer becomes proficient, some aspects may be come automatic.

Both S-R and cognitive learning may interact in a variety of situations. This dual approach is now held by many psychologists. Nevertheless, cognition has taken on an increasingly important role in psychology. Indeed, some psychologists have referred to the past 20 years as the "cognitive revolution in psychology".

OPTIMIZING LEARNING

Optimizing Learning:

Having seen the various forms of learning or learning principles, we have to focus on how they can be applied. Though research on learning suggest practical applications, it is rarely possible to move directly from research to the application aspect. So what is needed is that we have to look into the context, (i.e., setting) and try out the research findings in practical contexts and if the condition is different, we have to adjust accordingly. Now, for example, a drug may be found to kill the bacteria that causes a particular disease. This knowledge can he put to use, only after the proper dosage and method of administration are determined and the possible side effects evaluated. In this lesson, we will examine some findings related to problems of efficient learning and suggest how the learning process can be optimized.

So, we will concentrate on topics such as (1) the structure of an individuals knowledge base and how to enhance it, (2) the way in which learning one set of materials transfers to learning another (3) the significance of immediate feed back and (4) motivational and emotional factors that affect learning efficiency.

A number of teaching aids have been developed to promote learning. Motion pictures, audio visual tapes, and closed circuit TV have become important aids to instruction. Programmed tests and computer assisted instruction are new entrants and though they are in the developmental stage, we have to consider them because of the way in which they illustrate learning principles.

Let us begin with Programmed learning and automated instruction.

PROGRAMMED LEARNING AND AUTOMATED INSTRUCTION

For hundreds of years, teachers have been using the lecture method to impart learning. Students passed or failed depending on how much of the material learned, they could bring back to memory at the time of examination. This form of instruction obviously has drawbacks when compared to a tutorial arrangement. In a tutorial arrangement, there is a one to one relationship between the student and teacher. As tutorial education is a costly affairs, it is impractical on a large scale. It was Skinner who made an effort to incorporate some aspects of tutorial instruction in the form of a teaching machine. Skinner felt that many of ideas developed in the study of animal learning could he applied to the task of improving instruction.Let us see how the ideas developed in the study of animal learning are applied to human learning.

The basic idea here is that information is presented to the student in a series of frames. Each frame contains a new item of information and also present a question which the student must answer. The answer generally is a word or brief phrase. The student after writing the answer turns a knob that uncovers the correct answer. The student immediately knows whether his answer is correct or not. The next instruction frame is exposed to the student. The student answers the question and gets the feed back immediately. In this manner the student goes stepwise through a course. The method here is that the

student is gradually being introduced to each unit of instruction and being tested to see that he understands it.

Computer – assisted Learning: The entry of computers changed the scene. When computers entered the scene, it became evident that teaching devices could be developed that would be more flexible and responsive to the student than the Skinner-type teaching machine. The nature of education can be radically changed by the computer. The most significant feature of computerized instruction is that it permits a high degree of individualization, i.e., each student can proceed at his own pace depending on his/her capacity and interest. Each student can follow a path through the curriculum best suited to his particular interest and talents.

A computer can handle many students simultaneously as many as several thousand students each at a different point in one of several hundred different curriculum. (A station the area where the student works with the computer) is quipped with a cathode-ray-tube, a micro-film-display device, earphones and a typewriter keyboard. Each device is under computer control. The computer send out instruction to the terminal. The terminal displays a particular image on the microfilm projector. The message may be to write a message of text or construct a geometric figure on the cathode-ray-tube. Simultaneously the computer plays an auditory message. So what happens is that, the student sees the visual display, hears the auditory message and then has to respond. How does the student respond? The student respond by operating the typewriter key board or by touching the surface of the cathode-ray-tube with an electronic pencil. The response of the student is fed back to the computer and evaluated.

What happens after this? If the student is correct, the computer moves on to the next instructional item. If the student is incorrect the computer, evaluated the type of error committed, Depending on the type of mistake, the appropriate remedial material becomes available. A complete record is stored in the computer for each student. It is

updated whenever the student makes a new response. This record on each student is checked periodically to evaluate the students rate of progress and to determine whether the student has any particular difficulty. A student who progresses exceptionally, may be moved ahead in the lesson sequence, i.e., he will be exposed to lesson which are more difficult or he may move on to the next unit in that lesson sequence. It may also be like this; i.e., the student may be branched out to special materials designed to enrich his understanding of the curriculam. Now, what . It may also be like this; i.e., the student may be branched out to special materials designed to enrich his understanding of the curriculum. Now, what about students who have difficulty. These students may be branched back to review earlier materials or to a special remedial sequence. Computer aided instruction simulates the human tutorial process.

Presently computer assisted instruction has only limited development, but experience and research indicate that it will have wide application in the future. For example, computer aided instruction programs designed to teach reading in the early grades have proved successful. Those who received computer based instruction fared much better than those taught by traditional classroom methods. Another interesting finding related to sex differences in reading. Girls generally learn to read more rapidly than boys with traditional teaching methods. This sex difference in reading performance disappears with the computer aided instruction in reading program. Boys did well as the girls did and performed equally well on tests administered at the end of the school years. Computer aided instruction has also been used successfully at the college level.

Instructional Programs: Whether it is class room teaching or teaching with the help of computer, the essence of teaching lies in the arrangement of the material to be learned. A program is a body of material that is arranged is such manner so as to be readily mastered. Instructional programs have to basic formats: (1) the linear program and (2) the branching programs

In a linear programs, the student progresses along a single track from one frame to the next. Each time an item is answered the student moves on to the next item, irrespective of whether the response was correct. In this manner new information is gradually introduced and elaborated. Since the student has to make a response at each step, the student has to pay full attention to the material.

The branching programs allows the learner to take any number of different paths through the curriculum. Each response is evaluated. The evaluation determines where the student goes next. Whenever the student makes an error in response, it is pointed out. The student is given help to avoid making that error again. The student who does well as a number of questions may be given an opportunity to jump ahead. The student who makes many mistakes may retrace his steps or take an alternative route to resolve difficulties.

Linear programs do not need to be presented and sequenced by an automated device. To make it economical they are often printed in test book form. In the programmed text book, the answers to each frame usually are listed at the side of the page. The student covers the answer column with a slider, i.e., plastic strip and reads only one frame at a time. The student reads the frame, writes down his answer and then checks whether his answer is correct, i.e., the appropriate answer is uncovered. This method is adopted for the entire material, i.e., each time checking the answer to one frame before going on to the next.

There is controversy over the effectiveness of the two programs. Some investigations express the idea that all programs should be linear in form. Where as some others argue that complex branching programs are more effective. The matter is not as simple as this. The linear program is ideal for the formulation of some instructional materials, permitting the material to be distributed very economically. Some types of material require a branching program if it is to be effectively. If programs have to be successful, both linear and

branching segments can be utilized, but which format will be adopted depends upon the material being taught.

There is no definite set of rules for developing a successful program. It is not possible to prescribe a set of rules for formulating a successful one. Writing a good text book or preparing an impressive lecture is an art. In the same sense, development of a good text book is an art. The person who is constructing a program must have in mind the organization of knowledge, both its logical organization and psychological organization. Logical organization is what has to be known before something else can be understood. Psychological organization is how attention can be directed to significant aspects, generalizations made from prior information and so on.

Any program has to be tested out on a group of students. Subsequently it has to be revised to take care of the difficulties encountered. So it is tried on a second group and revised again until it seems to be adequate. Why should a program be revised successively? Successive revisions and improvement of a program are important as it focuses attention on the individual learning process thereby it enables the programmer isolate the difficulties, so that it can he analysed in detail as to how to be incorporated.

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We have seen computer assisted instruction and programmed instruction. What aspects of the above two make them effective teaching procedures? Let us look into those features. At least three features seem to be important. They include (1) active participation, (2) immediate feed back and (3) individualization of instruction. We will deal with each one now.

Active participation: The kind of learning that takes places during a lecture is passive. On the contrary in computer assisted instruction and instructional programs, the learner in actively interacting with the curriculum materials by responding, practicing and testing each step of the material to be leaned. Here the subject learns by doing, rather

than merely listening. Another example is learning by doing experiments in the laboratory.

Immediate feedback: This is exclusive to instructional programs and computer assisted instruction. With minimal delay, the learner comes to know whether the response is correct. He is able to correct an error immediately. Experimental evidence indicates that this type of immediate feedback or knowledge of results- reinforces the learner and produces faster learning.

Individualization of instruction: this advantage is not available to the lecture method. Here, the learner moves ahead at his own rate. The rapid learner can progress quickly through the material. The slow learner can move at his own pace (less rapidly). He is often directed to a remedial program, until he has mastered the basic concepts. In this context, it is the branching program that is ideal, because the learner moved through the material on a route designed to fit his aptitudes and abilities.

The instructional procedures which we have seen can be implemented with the technology available in the present day. Moreover they are economically feasible. Very soon computers will be able to recognize spoken words and understand the meaning of questions asked by students.

It is also felt that computers in education pose a threat to human individuality. Actually what happens is that computer aided instruction provides scope for better development of an individual potential. Book relieved student from the drudgery of oral recitation, like wise computers can free student from the drudgery of doing tasks not adjusted to their interests and needs.